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Alison & Halliwell.

Pneumatic Railway.

No. 44,376. Patented Sept. 20, 1864.

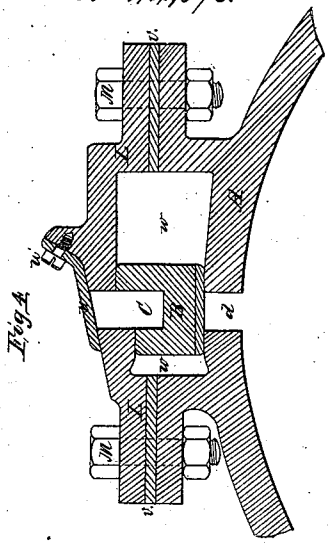

Fig 4

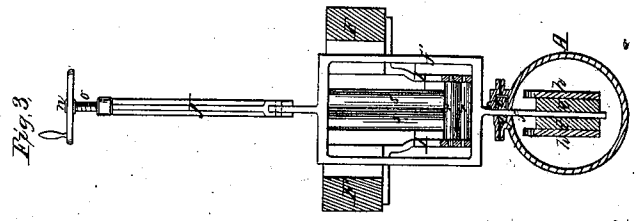

Fig 3

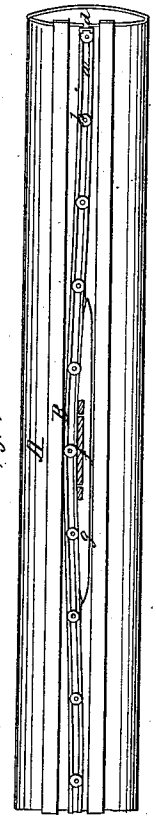

Fig 1

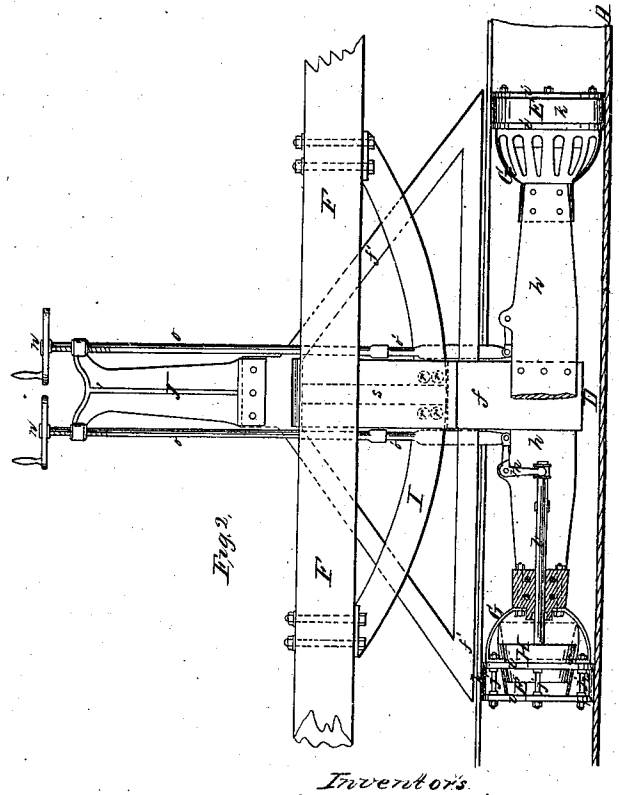

Fig 2

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Sheet 2, 2 Sheets.

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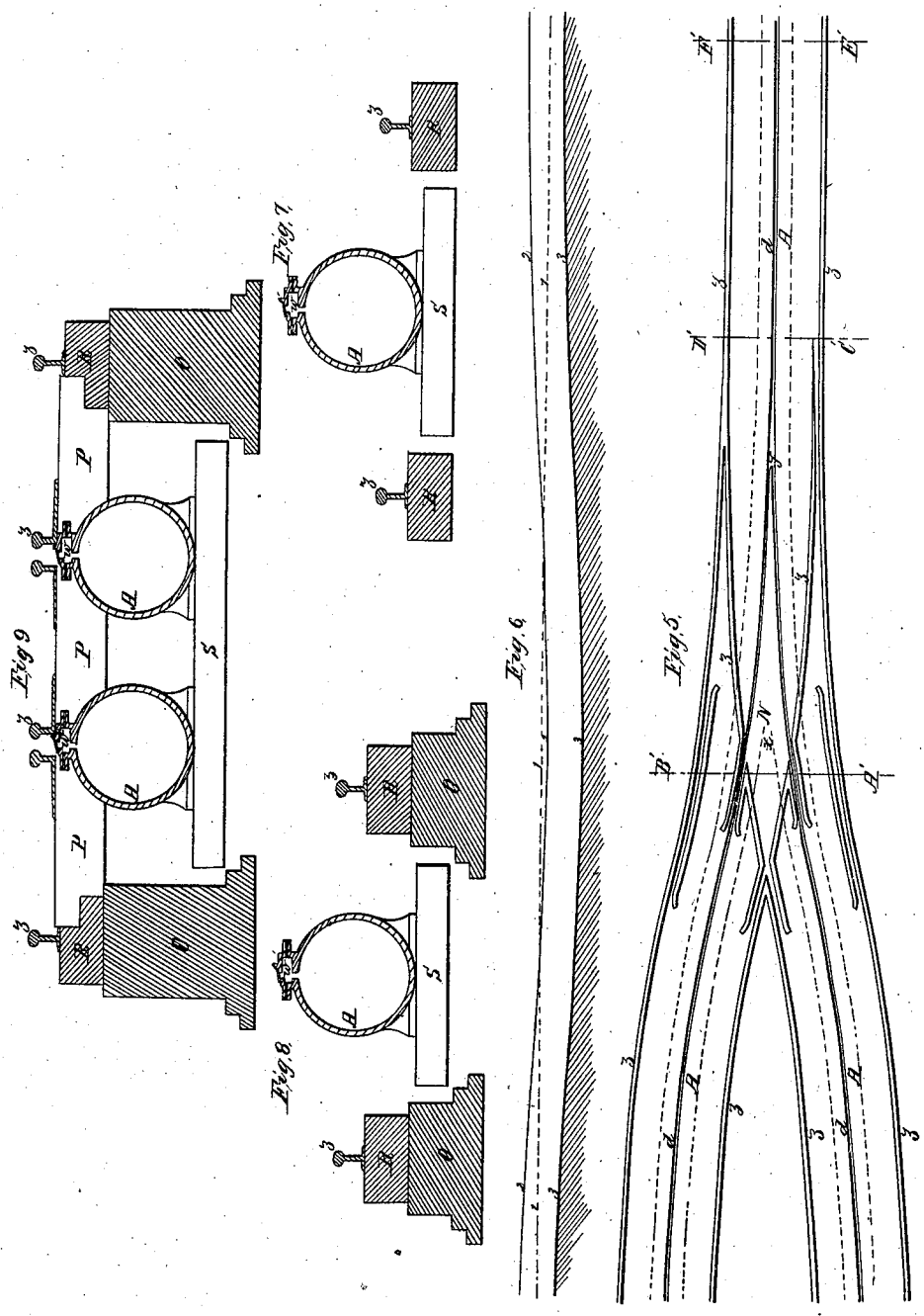

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UNITED STATES PATENT OFFICE.

ALEXANDER ALISON AND JAMES HALLIWELL, OF LONDON, ENGLAND.

IMPROVEMENT IN ATMOSPHERIC RAILWAYS.

Specification forming part of Letters Patent No. **44,376**, dated September 20, 1864.

To all whom it may concern:

Be it known that we, ALEXANDER ALISON and JAMES HALLIWELL, both of No. 2 Queen Street Place, in the city of London, in the Kingdom of Great Britain, have invented new and useful Improvements in Atmospheric Railways; and we do hereby declare that the following is a full and exact description thereof, reference being had to the annexed sheets of drawings, and to the letters and figures marked thereon, making a part of this specification, in which—

Figure 1 is a plan of the atmospheric tube, showing the line-valve; Fig. 2, a longitudinal section of said tube, showing the piston and other parts; Fig. 3, a transverse section of the same, showing the manner of connecting the piston to the piston-carriage *e*. Fig. 4 is a transverse section of the upper part of the tube, the line-valve, and other parts. Fig. 5 is a plan of the crossings for atmospheric railways, or shunting from one line to another. Fig. 6 is a section of the railway at the crossing, showing the dip of the tube. Fig. 7 is a transverse section on line E′ F′, Fig. 5; Fig. 8, a transverse section on line C′ D′; Fig. 9, a transverse section on line A′ B′, showing the manner in which the tubes are arranged at the crossing.

Like letters refer to corresponding parts in the several figures.

The nature of our invention consists, chiefly, in the novel construction and arrangement of the line-valve and mode of operating the same; in the peculiar construction of the piston head; in the device for operating the valves in the piston-head, and to the means adopted for shunting the train or crossing from one line to another.

The line-tube A is made of cast-iron or other suitable material, and may be of any required size and convenient shape. The line-valve B, Figs. 1 and 4, composed of the links or plates *a*, connected by hinge or rule joints *b*, covers the aperture *d* in the line-tube. The links or plates may be secured together by means of pins at the joints *b*, if found desirable. A continuous strip or sole of leather, *c*, is fixed to the under side of the plates *a*, which effectually prevents the passage of air through the aperture *d* when covered by the line-valve B. The plates or links *a* are constructed with a longitudinal groove in their upper surface, as shown in Fig. 1, forming a part of the channel C, Fig. 4. Through this channel the curved bar *e*, Fig. 3, extending the length of the piston, passes, thereby removing the line-valve B from the aperture *d* the distance shown in Fig. 1, to admit the passage of the piston-rod or plate *f*, Figs. 1, 2, and 3, in whichever direction the piston D is moving. As the piston-rod passes along the tube the rear end of the curved bar *e* returns the line-valve to its position on the aperture *d*, which obviates the necessity of using for this purpose springs or other equivalent devices. Suitable guides or stops may be employed at intervals along the line to prevent any longitudinal movement of the valve B. The bar *e*, which is only shown by a transverse section in Fig. 3, is secured at its ends to the bottom of the frame *f′*. At the center it is bolted to the piston-rod *f* and the bar *g*, Fig. 1. The bar *g* is further connected to the curved bar *e* by a piece extending from one to the other on both rear and front of the piston-bar *f*. The principal object of the bar *g* is to secure increased steadiness to the curved bar *e*; but in case the latter was disabled the former would remove the valve from the aperture *d* for the passage of the piston-rod *f*, and thereby prevent any serious injury to the valve or other parts.

The piston D, Fig. 2, is formed with two ends or heads E. These ends are fixed in practice about eight feet apart, thereby securing great steadiness to the piston as it moves through the line-tube A. Air being admitted into the space between the ends of the piston by the uncovering of successive portions of the aperture *d* prevents any pressure of air upon the line-valve B near the piston-rod *f*, thereby lessening greatly the amount of friction in the working parts. The employment of two heads also prevents the air, admitted into the tube by the removal of the valve B from the aperture, affecting the vacuum in front of the piston as well as the escape of air from the rear of the piston, when the latter is moved partially or entirely by means of compressed air.

The two ends E of the piston, Fig. 2, which are firmly secured together by means of the cheeks or plates *h*, Fig. 2, are each formed of two metallic rings, *i*, connected together by three or more bolts, *j*. The packing is formed

of a thick band, *k*, composed of india-rubber or other elastic material. The bolts *j* pass through this band, by which means it is kept in position between the rings *i i*. The band *k* has a covering of leather or other durable material to lessen the friction, which is formed in pieces and secured to said band near each bolt, *i*, and is also provided with a similar lining.—The end E is firmly fixed to the dome F, the latter being cast with or secured to a block, G′, which is bolted to the plates *h*, as shown in Fig. 2. The dome G is formed with apertures to admit the passage of air when the piston-valve is open. This valve, in each head, composed of a cone, H, is operated by the conductor through the device shown in Fig. 2, consisting of the rods *l o o′*, bell-crank *n*, and hand-wheel *n*. When the cone-valve H is closed, the elastic band *k* is extended to closely fit the interior surface of the line-tube, and the same being withdrawn this band contracts, when the leather covering will only come in contact with the tube where the bolts are placed, thereby lessening the friction and, consequently, the wear of the parts. The cone-valve H is keyed on the rod *l*, which passes through the block G′, and is connected at its opposite end to the bell-crank *n*. The rod *o* is connected to the rod *o′* either by a socket-joint or other suitable means, so that by turning the wheel *n*, fixed to the rod *o*, the rod *o′* is not rotated, but merely raised or lowered, as it may be desired to open or close the cone-valve H. The end of the pistons may be formed to act as valves, but the mode described is more desirable.

One of the pistons or valves *h* may be kept open while the train is running if at any time found desirable; but by the use of two heads the moving power may be conveniently obtained solely by creating a vacuum in front of the piston or by compressing the air in the rear, or the two means may be simultaneously employed.

The speed of the train may generally be regulated simply by adjusting the cone-valves H. When it is desired to entirely stop the train, these valves may be simultaneously withdrawn, the apertures in the dome G permitting the air to readily pass through the piston, the ordinary brakes being at the same time applied to the wheels of the carriage. To insure the more sudden stoppage of a train in case of accident, slide-valves may be fixed at suitable distances along the line for the purpose of closing the tube either in front or rear of the train, by which means the vacuum is destroyed or the pressure resisted. These valves may be worked by any convenient device so as to be under the control of the conductor as the train passes along the line.

The two curved plates I, Fig. 3, one of which is shown in Fig. 2, are firmly fixed to the bottom of the piston-carriage F. The four horizontal friction-rollers *r* have their bearings in these plates, as shown in Figs. 2 and 3. The two vertical guide-rollers *s* have their bearings in the frame *f′*. When motion is given to the piston in either direction, the rollers *s* press against the two forward rollers *r r*, thereby propelling the carriage F, to which the train is attached. Fixed to the frame *f′* is the standard J, carrying the spindle *o*. The spaces between the plates *h* and the piston-rod *f* are filled with the pieces *t*, Fig. 3, and all are firmly secured together, as shown in Fig. 2.

The cap-pieces L, Fig. 4, with the top of the tube A, constitute the chamber *w*, in which the line-valve B works. A desirable form for the chamber *w* is clearly shown in Fig. 4. This chamber is made deeper at the ends than near the aperture *d*, in order to prevent any binding of the valve as the latter is removed from said aperture, and one side is made deeper than the other to admit the piece that binds together bars *e g*. The channel C, through which the curved bar *e* moves, is clearly shown in Fig. 4. This channel is covered by a cap, *u*, formed of leather or other yielding material, and confined on one edge by the screws *w′*. This cap is raised by the passage of the piston-rod *f* and weights may be fixed near the unconfined edge to return it to its position over the channel C. The sole or bed *c* of the valve is made of leather or other suitable material to make a tight joint without much friction, and the spaces *v* are filled with some yielding substance, in order that the cap-pieces L may be readily adjusted as the parts wear by means of the screw-bolts M.

The plan adopted for joining two tubes, A, so as to allow of the shunting of the train or crossing from one line to another, is illustrated in Fig. 5. The tube is divided at the point N, the fork *x* being rounded off, so as to form bell-mouths to the branches, and a similar division is made at the point *y* in the valve B and aperture *d*. When the parts are thus constructed, the flanges of the wheels of the propelling-carriage, which moves some distance in advance of the piston, guide the latter into the desired line of tubes, the points of the railway-line being shifted in the ordinary manner. If found desirable, however, a shifting tongue-piece or guide may be used in the tube A. This tube is sunk below the level of the rails, as shown in Fig. 6. The horizontal line 1 1 1 represents the level of the rails, the curved line 2 2 2 the top of the tube A, and the curved line 3 3 3 the bottom of said tube. The tube A is thus sunk at the crossing to allow the rails to come sufficiently near to form a crossing, leaving sufficient space for the piston-rod to pass, as shown in Fig. 5, and to prevent the flanges of the wheels coming in contact with the valve-chamber. The piston D readily follows the dip of the tube, the frame *f′* being arranged to move vertically as well as laterally independent of the bottom of the piston-carriage F. These independent movements prevent any jerking or oscillation of the carriage F from affecting the regular motion of the piston D. The

rollers *r* and *s* reduce the friction consequent upon the jerking or oscillation of the carriage F, and for this reason only are preferable to plain rods. The tube A should rest on sleepers disconnected with the sleepers R, which sustain the rails *z*, as shown in Fig. 7. This figure shows the ordinary relative position of the tube A and rails *z*, (line E′ F′, Fig. 5,) while Fig. 8 shows the relative position in the line C′ D′, near the crossing, and Fig. 9 the relative position of the different parts on the line A′ B′ at the crossing. In practice, however, the timbers P, Fig. 9, would be sustained at the ends nearest the tube A by supports disconnected with said tube, as well as at the opposite end by the independent foundation O.

An atmospheric railway constructed upon the plan described admits of the successful working of lines with steep gradients, thereby greatly reducing the cost of grading in hilly districts, while the cost of the required permanent way and plant is much less than for a locomotive-line. The injury to the permanent way caused by the running of a heavy locomotive on ordinary lines is entirely avoided, thereby greatly reducing the cost of repairs, and there is very little danger of accidents to the train.

A part of the improvements hereinbefore described may be advantageously applied to other purposes, such, for instance, as raising coal or other minerals from deep pits. This application may be made without essentially modifying the parts employed. Two atmospheric tubes are placed vertically in the shaft with a cross-bar connecting the two pistons. The tubes are a sufficient distance apart to allow the passage of a cage suspended to the cross-bar, or a car resting on a platform supported by the cross-bar. The tubes are each provided with a double-headed piston, to which the cross-bar is fixed in a manner similar to the piston rod *f*, Fig. 2, and also with a valve, B, valve-chamber *w*, and other parts, constructed in a manner similar to that described. The line-valve is operated by means of a curved rod, and the platform is raised by means of a vacuum in the tube above, or by forcing air into the tube below the piston. The cage or car is let down the shaft by admitting air above the piston by opening a valve, at the same time opening a valve near the bottom of the tube for the escape of air displaced by the descent of the piston. These valves may be arranged and operated in any convenient manner. By the employment of this plan in raising coals and other substances a great height a large saving is effected in the required power, as the weight of the chains or ropes by which the cage is generally raised is frequently greater than that of the load. The liability to accidents is much reduced, as most of the danger is now from the insecurity of the ropes, while the air that is discharged from the bottom of the tube will serve to ventilate the pit.

Having thus fully described the construction of our invention and shown how it may be conveniently applied to practical purposes, we wish it understood that we do not confine ourselves to the exact details herein set forth, but we claim and desire to secure by Letters Patent of the United States—

1. The valve *a*, whether employed for railway or other purposes, and when used in combination with the chamber *w*, or without said chamber, constructed substantially as described.

2. The curved bar *e*, for removing the valve *a* from the aperture *d* and returning the same after the passage of the piston-rod *f*, substantially as described.

3. The elastic packing-bands *j*, when used on a piston-head, for the purpose and substantially in the manner specified.

4. The cone-valve H, whether used in a solid piston-head or in combination with the elastic band *j*, constructed and arranged for the purpose and substantially in the manner specified.

5. The device for operating the cone-valve H, constructed and arranged substantially in the manner specified.

6. The frame *f*′, with guide-rollers *s*, so arranged with reference to the bottom of the carriage P as to allow the piston D to follow the dip of the tube at the crossings, and to prevent any vertical motion of the carriage affecting the said piston.

7. The frame I, with guide-rollers *r*, so arranged with reference to the frame *f*′ as to prevent the oscillation of the carriage P being communicated to the piston D.

8. The branching of the tube A at N, Fig. 5, and the branching of the aperture *d* at *y*, in connection with the dip of said tube, for the purpose of conveniently shunting the train or passing from one line of rails to another.

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